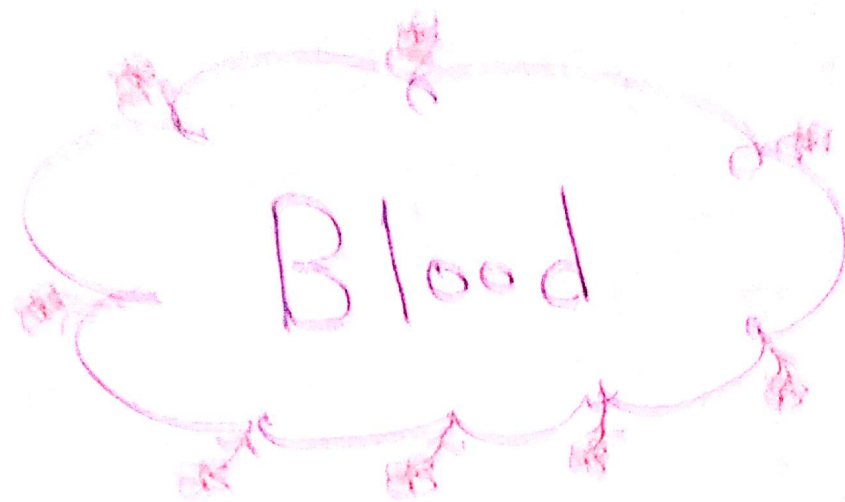




4 Questions

VISIT...

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1 Function of blood & Types and Functions of plasma protein & A/B ratio?

* Function of blood

- ① Transport of
 - Respiratory gas
 - Nutrient
 - Waste products
 - Hormone and enzyme and vitamin
- ② Defense against
 - phagocytic
 - anti body
 - anti toxins
- ③ Haemostasis (stoppage of bleeding)
- ④ Homostasis (Regulation of)
 - pH
 - Temperature
 - Water content
 - Hormone secretion

* Types of plasma protein

- | | | |
|---------------|----------|----------------|
| ① Albumin | 4 gm % |] Total 7 gm % |
| ② Globulins | 2.7 gm % | |
| ③ Fibrinogen | 0.3 gm % | |
| ④ prothrombin | 1.0 mg % | |

* Functions of plasma protein

- ① blood clotting by Fibrinogen and prothrombin
- ② blood Viscosity by fibrinogen and globulin
- ③ Defence and protection by γ -globulin
- ④ osmotic Pressure by albumin
- ⑤ Buffering action
- ⑥ Capillary permeability
- ⑦ Carbon dioxide transport
- ⑧ Regulating the activity of substance (conservation)
- ⑨ Nutrition function during starvation (reserve protein)

BBD^o

BCCRN

* (A/G ratio)

* definition (The ratio of Albumin and Globulin in the plasma)

* Normal Value 1.2 - 1.7

- It is 1.2 If plasma protein separated by electrophoresis
- It is 1.7 If by Salting out Method

* Clinical importance

It decrease ↓ in

- ① liver disease e.g. hepatitis
- ② Renal disease e.g. nephrosis
- ③ Infections and allergy

It increase ↑ in

- ① hypogammaglobulinemia
- ② AIDS

2 Function of RBCs & Factors affecting erythropoiesis & hemoglobin & anemias Blood Transfusion & Rh factor & erythroblastosis fetalis?

* Function of RBCs ~~1.2.3.4~~ + membrane

- ① Hemoglobin of RBCs important for

Transport of O_2

Transport of CO_2

Buffering the blood pH
- ② Carbonic anhydrase enzyme of RBCs important for
Buffering of CO_2 released from tissue
- ③ Histaminase enzyme of RBCs important for in activates histamine

* Factor affecting Erythropoiesis (HDHLB) ~~1.2.3.4~~

- ① Hypoxia (O_2 lack stimulates erythropoietin hormone)
- ② Diet
 - (a) protein It responsible of formation globin part of HB
 - (b) Iron " " " " " Haem part of HB
 - (c) vitamins eg Vit B12 - folic acid - Vit C
 - (d) other elements eg Copper Cu - cobalt Co
- ③ Hormones
 - eg (a) Thyroxine
 - (b) cortisol
 - (c) Testosterone

⑤ ~~Testosterone~~ Erythropoietin - Formed in
85% by kidney, 15% by liver.
- ④ Liver It used for synthesis RBCs and storage iron/vit B12
- ⑤ Bone marrow It used for synthesis RBCs

* Hemoglobin

* definition (It carries O_2 in RBCs and It consists of 4 subunits 2α & 2β and globin and heme)

* Types

- ① **HBA** present in Normal adult human HB contain 2α chains and 2β chains
141 amino acids 146 amino acids
- ② **HBA₂** " " " " contain $\alpha_2 \gamma_2$
- ③ **HBF** present in Normal fetal contain $\alpha_2 \gamma_2$

* abnormality of HB formation

- ① Haemoglobinopathies abnormal polypeptide chain are produced
eg Hbs formation in sickle-cell anemia
- ② Thalassemias
 - α -Thalassemia in which α -chain decreased @ absent
 - β -Thalassemia in which β -chain decreased @ absent

* Hemoglobin content of Blood

- in adult male 16gm Hb%
- in female 14gm Hb%
- average 15gm Hb%

* Reaction of HB with O_2

- Hb bind O_2 to form oxyhaemoglobin
- O_2 is attached to iron of Heme present in the ferrous state Fe^{2+}
- factor ↓ affinity of Hb to O_2

① ↑ H^+ — CO_2 — Temperature — 2,3-DPG

② ↑ release of O_2 to the tissue

* Anemia

* definition (abnormally low hemoglobin concentration in the blood)

* Classification

1 According to The characteristic features of The RBCs

- 1- Normocytic normochromic anemia It occurs in hemorrhage aplastic anemia
- 2- Microcytic hypochromic anemia It occurs in iron deficiency Thalassemia
- 3- Macrocytic anemia It occurs in vit B12 deficiency

2 According to underlying cause of Anemia

1- Deficiency anemias

which result from (deficiency of any of The essential element for erythropoiesis e.g Iron deficiency)

2- Aplastic anemias

which result from (inability of The bone marrow to produce RBCs)

3- Hemolytic anemias

which result from (excessive hemolysis of The RBCs)

4- Blood Loss anemia (As in hemorrhage)

* effect of Anemia on The body

1- hyperkinetic circulation As ↓ blood viscosity

2- Hypoxia ↓ O_2 carrying capacity of The blood

3- low tolerance to exercise ↓ rate of activity → cardiac failure

4- Atherosclerosis and intravascular Thrombosis

* Blood Transfusion

* definition (transfusion of plasma OR RBCs OR WBCs OR platelets OR other components)
From person to other OR other functions

* Indication of Blood Transfusion

- 1- To restore blood volume
- 2- To improve O_2 transport to tissue
- 3- Treated sepsis associated with agranulocytosis
- 4- lack of RBCs
- 5- lack of specific clotting factors
- 6- lack of platelets
- 7- lack of WBCs
- 8- lack of γ -globulins

* Precautions before Blood Transfusion

- 1- The donor's blood should be compatible with that of recipient
- 2- Cross matching test should be done before Transfusion
- 3- Hb of transfused blood should be normal
- 4- Transfused blood should be free from diseases
- 5- Fresh OR recently stored

5- hick → Dangers of Blood Transfusion

- ① Dangers of incompatibility
 - 1- Agglutination of the donor's RBCs
 - 2- Hemolysis of " "
 - 3- hypotension
 - 4- decrease urine volume (renal failure)
- ② Transmission of Diseases e.g.
 - 1- syphilis
 - 2- malaria
 - 3- hepatitis
 - 4- AIDS
- ③ Allergic reaction e.g.
 - 1- Rigors
 - 2- fever
- ④ Transfusion of excessive amount of blood leads to heart failure
- ⑤ Tetany ↑ neuromuscular excitability

* Rh factor

* definition (It is an antigen which was discovered in the RBCs of Rhesus monkey)

- It is present in 85% of people called Rh-positive
- It is absent in 15% of people called Rh-negative

* Clinical significance of Rh-antigen

① in Blood transfusion

* If Rh -ve person → Rh +ve person

occur anti Rh antibodies develop in his plasma

* If he needs second blood transfusion and is given Rh +ve

occur agglutination of the donor's RBCs

2 In pregnancy * If Rh (+ve) male married Rh (-ve) female
The fetus will be Rh (+ve) in most cases.

5

* During delivery some fetal RBCs containing the Rh-antigen
It may cross the placenta to reach the mother's blood
she becomes sensitized

* If his mother becomes pregnant again with Rh (+ve) fetus

↳ cause hemolysis of his RBCs and die

* Erythroblastosis Fetalis

* definition (This disease results from Rh incompatibility in the fetus)

* in pregnancy دولت دولت

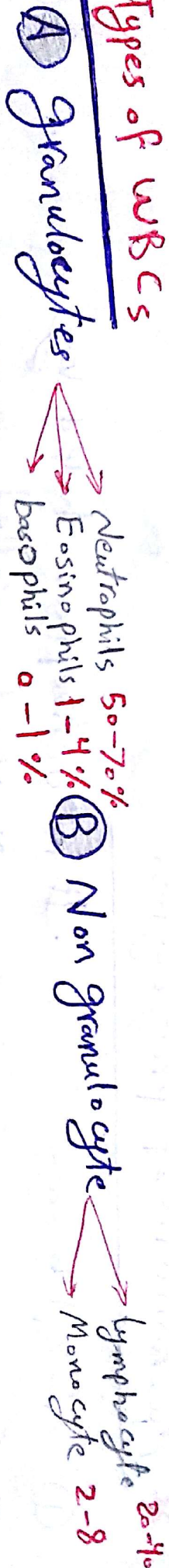
* If the infant survives the anemia, the passage of bile pigment to brain
causes Kernicterus i.e. damage of the basal ganglia

* Treatment

- 1- Repeated exchange transfusion of the baby's blood with Rh (-ve) blood
- 2- injection of anti Rh-antibodies to the Rh (-ve) mother's blood
- 3- An Rh (-ve) female should never be transfused Rh (+ve) blood

3] White blood cells (Types - Function) & Mechanism of Phagocytosis & Types of immunity

* Types of WBCs



* Function of WBCs

II Neutrophils → They are highly phagocytic i.e. They have defensive function against bacteria

by steps :-

- M 1- Margination Neutrophils stick to damaged capillary walls
- D 2- Diapedesis WBCs squeeze themselves through narrow pores
- A 3- Amoeboid movement Neutrophils move in the tissue spaces to reach bacteria
- C 4- Chemotaxis i.e. attraction of neutrophils towards inflammation
- P 5- Phagocytosis + Mechanism of Phagocytosis

- 2 Eosinophils →
- ① They are related to allergy and hypersensitivity
 - ② They are increased in allergic conditions and parasitic worm infestations
 - ③ They absorb histamine
 - ④ They prevent toxic effects of foreign protein
 - ⑤ They are weak phagocytes

- 3 Basophils
- ① They store heparin / histamine / bradykinin / serotonin
 - ② They secrete heparin
 - ③ They are related to allergy
 - ④ They are not phagocytes

4 Lymphocytes

- * B-lymphocyte → responsible for humoral immunity
- * T-lymphocyte → " " cell mediated immunity
- * Natural Killer cell → act as defence against viral infection and destroy malignant cell

- 5 Monocyte
- They are →
- ① highly phagocytic
 - ② important role in cell mediated immunity
 - ③ secrete interleukin-1 which stimulates reproduction of specific lymphocyte

→ 1) highly phagocytic

② important role in cell mediated immunity

③ secrete interleukin-1 which stimulates reproduction of specific lymphocyte

* Mechanism of phagocytosis

① Neutrophils engulf bacteria. It is active process helped by opsonins as IgG

② The ingested bacteria in phagocytic vacuoles called phagosomes

③ proteolytic enzymes and lipases digest bacteria

④ Antimicrobial antibiotic called defensins

⑤ oxidizing agents eg a O_2^-
b H_2O_2
c OH^- > help the phagocytes bacteria

⑥ Myeloperoxidase catalyses the reaction between H_2O_2 and Cl^- to form hypochlorite

⑦ Lysosome causes dissolution of membranes of the bacteria

⑧ Neutrophils die during attacking bacteria form pus cells

^{sjer}
^{bas} *** Type of immunity** → (The ability to resist invasion by foreign bodies and destroy the invader)

(A) Innate immunity (inborn = natural)

*** definition** [It is non specific immunity which provide non specific protection against invasion by foreign bodies]

e.g in

1- skin

2- HCl

3- phagocytic RBCs

4- lysozyme

5- Respiratory system as hair in nose

6- urogenital system as Acidity in urine

7- interferon

8- tonsils and spleen

(B) Acquired immunity (specific)

*** definition** [It is specific immunity which provide specific protection against specific foreign bodies]

*** Types**

① **Cellular immunity** This is the immunity mediated by the T-lymphocytes
→ protect against viruses / Fungi / TB / Few bacteria

② **Humoral immunity** This is the immunity mediated by the B-lymphocyte
→ protect against bacteria only

4 Platelets (Function and mechanism of blood coagulation & anticoagulants
& hemostasis & role of Vitamin K and calcium & Fibrinolytic system & causes of Fluidity of blood & intra vascular Thrombosis & hemophilia & purpura)

* Function of platelets

1 Hemostasis

occur by

- * They aggregate to form platelet plug
- * They release serotonin and Thromboxan A₂
- * " " platelet Factor 3 & 4
- * " " von Willebrand Factor
- * " " clotting factor V

⊗ stabilization of Plug

2 Clot retraction

After Fibrin is formed, platelets get attached to fibrin fibers.
→ Then contract leading to shrinking of the clot.

3 Wound healing

Platelets release a polypeptide called platelets derived growth factor **PDGF**
→ which stimulates wound healing. This substance is also released by Macrophage and endothelial cell.

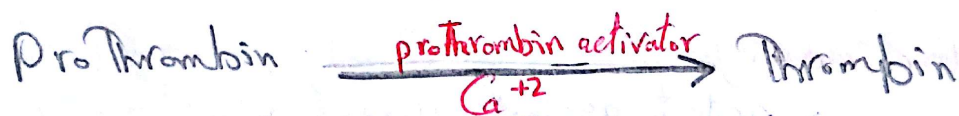
* Mechanism of blood coagulation

It occurs through 4 steps

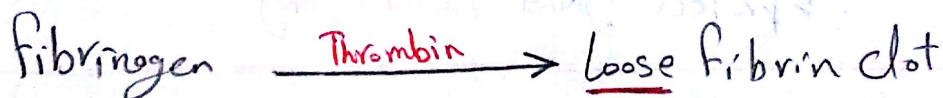
① Activation of Factor X Factor X can be activated by 2 systems

Intrinsic system	Extrinsic system
1- activated within 4-8 minutes	1- activated within 12-20 seconds
2- Triggered by <u>electronegatively</u> charged surface <u>As glass</u>	2- Triggered by <u>tissue damage</u> releasing Thromboplastin TPL
3- Factor needed are XII-XI-X IX-VIII-V- Ca^{+2} -PL	3- Factor needed are V-VII-X- Ca^{+2} -TPL
4- occurs in <u>Vivo</u> and <u>Vitro</u>	4- occurs in <u>Vivo</u> only

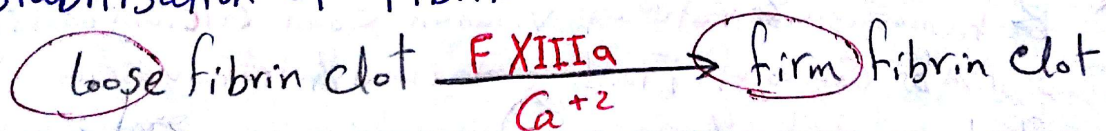
② Conversion of prothrombin to Thrombin



③ Conversion of fibrinogen to insoluble fibrin



④ stabilisation of fibrin



* Anti - Coagulants ~~(1.1.18)~~

I In Vivo (inside the body)

- 1- heparin
- 2- Vitamin K
- 3- Direct Thrombin inhibitors
- 4- Factor Xa inhibitors

- 5- Roughness of the endothelial lining
- 6- Adrenaline

II In Vitro (outside the body)

- 1- precipitation of ionised Ca^{+2}
- 2- binding Ca^{+2} in ionised form
- 3- preventing the aggregation and breakdown of platelets
- 4- De fibrination of blood
- 5- Cooling blood rapidly into zero°C
- 6- Addition of heparin

* Role of Vitamin K in blood Coagulation

- ① It is essential for formation of prothrombin and factors VII-IX-X
- ② It acts as cofactor for the enzymatic formation of these substances ^{in the liver}
- ③ It catalyzes γ carboxylation of glutamic acid residues on various proteins

^{Vitamin} * K deficiency Causes (① Prolonged coagulation time and ② caused haemorrhage)

* Role of Ca^{+2}

It is essential for

- ① formation of active Thromboplastins
- ② conversion of prothrombin $\rightarrow$ Thrombin
- ③ stabilisation of soft fibrin clot

* Causes of Normal Fluidity of blood

Normally - blood clotting inside the blood is prevented by

- ① Normal blood flow rate
- ② Endothelial lining of blood vessels in healthy and smooth
- ③ presence of anti Thrombin III in plasma
- ④ " " heparin in plasma
- ⑤ Fibrinolytic system
- ⑥ clotting factors are present in plasma in an inactive form

* Intra Vascular clotting (Thrombosis)

* definition (It is The formation of blood clot inside blood vessel)

* The condition helped by

- 1- slow blood flow
- 2- exposure of collagen fibers
- 3- ↑ number and sticking of platelets
- 4- ↑ Fibrinogen content and viscosity of blood

* Effect intra vascular clotting

In Veins

- * Venous obstruction
 - * ↑ Venous pressure
 - * ↑ Capillary pressure
- local edema

In Arteries

- * Coronary obstruction
- * Paralysis
- * ↓ blood supply
- * Myocardial infarction
- * eye blindness

* Treatment

→ aspirin
→ heparin or dicumarol injection

* Fibrinolytic system (fibrinolysis)

* definition (breakdown and removal of blood clot to keep the fluidity of blood)

Plasmin

- * It is the active component of fibrinolytic system
- * It is formed from inactive precursor called plasminogen (Through the following steps)

- 1- All endothelial cells produce Thrombomodulin
- 2- The Thrombomodulin-Thrombin complex activates protein C
- 3- Activated protein C along with its cofactor protein S causes
 - a) inactivation of factor V and VIII
 - b) ↑ formation of plasmin → ✗
- 4- TPA is activated and with Thrombin convert plasminogen → plasmin

* Significance of fibrinolysis

- Keeps fluidity of blood inside blood vessels
- Re open blood vessels
- Keeps fluidity of menstrual blood

* Haemophilia

* definition (It is an inherited, sex linked disease transmitted by females to male who are usually affected)

It causes

- 1* Coagulation time Prolonged
- 2* bleeding time Normal
- 3* clot retraction Normal

* Cause ↓ factor $\begin{matrix} \text{VII} \\ \text{IX} \\ \text{XI} \end{matrix}$

* Types A - B - C

- Haemophilia A due to ↓ factor VII
- Haemophilia B due to ↓ factor IX
- Haemophilia C due to ↓ factor XI

* Treatment

- ① Fresh blood transfusion
- ② give the deficient factor

* Purpura

* definition (It is a disease characterised by many small subcutaneous and mucous membrane haemorrhage affect both male and female)

It causes

- 1* Coagulation time Normal
- 2* bleeding time Prolonged
- 3* clot retraction Slow

* Cause ↓ platelets

* Type $\begin{cases} \text{Thrombocytopenic} \\ \text{Thrombasthenic} \end{cases}$

* Purpura may be due to (↑) fragility of capillary walls e.g. Scurvy